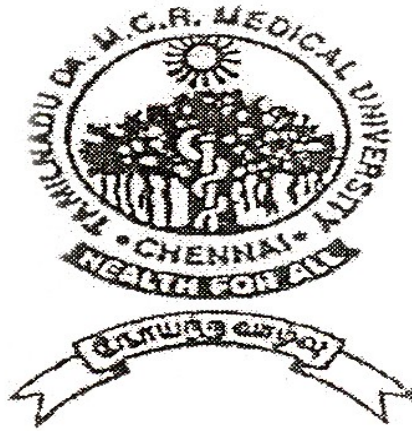


THE DISSERTATION ON
MANAGEMENT OF CHOLEDOCHOLITHIASIS WITH SPECIAL
REFERENCE TO USE OF CHOLEDOCHOSCOPY

M.Ch.BRANCH-VI
SURGICAL GASTROENTEROLOGY& PROCTOLOGY



THE TAMILNADU Dr.M.G.R.MEDICAL UNIVERSITY
CHENNAI- TAMIL NADU

AUGUST -2007

CERTIFICATE

Certified that this dissertation entitled “MANAGEMENT OF
CHOLEDOCHOLITHIASIS WITH SPECIAL REFERENCE TO USE OF
CHOLEDOCHOSCOPY” is the bonafide work done by Dr.C.SUGUMAR,
during the period 2004- 2007 ,done under my guidance and supervision and is
submitted in partial fulfilment of the requirement for the M.Ch (BRANCH –VI)
-Surgical Gastroenterology & proctology of The Tamilnadu Dr.M.G.R Medical
university , August 2007 examination .

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MANAGEMENT OF CHOLEDOCHOLITHIASIS WITH SPECIAL REFERENCE TO USE OF CHOLEDOCHOSCOPY

INTRODUCTION

Gall stone disease affects people from every society, race, gender and age group. More than 95% of biliary tract disorders are related to gallstone ¹. Most bile duct stones are stones that have passed into bile duct from the gallbladder.

Cholelithiasis means stones in the bile duct. Stones are non crumbling concretions larger than 2mm in diameter and biliary microlithiasis are particles 2mm or less in diameter although there is no universally accepted definition ². Sludge is suspension of cholesterol monohydrate crystals, calcium bilirubinate granules, and or other calcium salts with or without microlithiasis of gall bladder mucus. Sludge is a form of gall stone disease and may predispose to macroscopic stones or directly cause pancreatitis and other morbidity.

Despite good surgical techniques, about 8% to 16% of patients have retained stones in common bile duct after conventional choledocholithotomy ^{3, 4}. Common bile duct stone is defined as retained if they are discovered within two years of cholecystectomy or recurrence if they are detected more than two years after cholecystectomy.⁵

To reduce the incidence of retained stones in the common bile duct, operative flexible choledochoscopy was introduced into clinical practice in 1970's. Moreover surgery has been associated with a discouragingly high incidence of residual stones. Many studies since then have confirmed the value of flexible choledochoscopy as a reliable method of reducing the incidence of retained biliary tract stones. The reported incidence varied between 0% to 7% ⁶.

In India, limited study is available regarding the use of operative choledochoscopy in the management of choledocholithiasis. ERCP facilities are not available in many centres

and requires the expertise of a medical gastroenterologist. In contrast, operative choledochoscopy is a simpler procedure that can easily be learnt and practised by many surgeons at the time of exploration of common bile duct.

This study was undertaken with an aim to investigate how flexible choledochoscopy lowered the incidence of retained stones in the common bile duct after the exploration.

AIM OF STUDY

1. To evaluate the role of operative flexible choledochoscopy after choledocholithotomy / transcystic choledochoscopy in reducing the incidence of retained stones in the common bile duct.
2. To study the epidemiology and clinical features of choledocholithiasis.
3. To study the surgical modes of management of common bile duct stone.
4. To study the operative finding in terms of gall bladder / common bile duct stone
5. To study the complications of surgical procedures
6. To study the role of T tube cholangiogram, ultrasound, magnetic resonance cholangio pancreatogram in detecting any retained stones in the common bile duct.

MATERIALS AND METHODS

The patients who had their common bile duct explored for proven common bile duct stones during three years period from 2004 to 2007 were reviewed prospectively at Government General Hospital, Chennai in Department of Surgical Gastroenterology.

During this period forty four patients with confirmed common bile duct stone with or without gallstones were chosen.

Initial decision to explore the common bile duct was made by ultrasound in 20 patients (45%), ERCP in 8 patients (18%), CT in 10 patients (23%), MRCP in 6 patients (14%) is given in Figure 1.

In addition, inclusion criteria and exclusion criteria were used to select the patients for common bile duct exploration using flexible choledochoscopy.

INCLUSION CRITERIA FOR CBD EXPLORATION

1. Cholelithiasis with history of jaundice.
2. Sonographic / ERCP / CT/ MRI evidence of common bile duct stone.
3. Patient with cholelithiasis with raised serum alkaline phosphatase and raised serum gamma glutamyl transferase.

EXCLUSION CRITERIA FOR CBD EXPLORATION

1. Patient with common bile duct stones who refused operative treatment.
2. Patient with common bile duct stones who were medically unfit for operation.

All patients in whom common bile duct was explored were given antibiotic prophylaxis (Inj cefotaxime 1gm intravenously) during the induction of anaesthesia. Out of forty four patients excluding six patients (5 had previous cholecystectomy, one had cholecystectomy with choledochal cyst excision) all the remaining thirty eight patients underwent

cholecystectomy. Conventional common bile duct exploration was done through the choledochotomy incision or through transcystic route (in dilated cystic duct) using desjardin's forceps . Then common bile duct was explored either through choledochotomy or through transcystic route using a choledochoscopy. In our study we used flexible video choledochoscopy (PENTAX FCN -15X) as diagnostic and therapeutic procedure.

The bile duct stone picked up by the choledochoscopy was removed using dormia basket. Saline irrigation was done to remove biliary sludge. Completion choledochoscopy was done to examine the common bile duct, common hepatic duct, right and left hepatic ducts. After confirming there were no residual stones, patients were subjected to surgical procedure based on common bile duct diameter. Patients with dilated common bile duct ($>15\text{mm}$) underwent choledochoduodenostomy or choledochojejunostomy or primary closure of CBD . Patients with undilated common bile duct ($<15\text{mm}$) underwent closure with 'T tube' drainage.

All patients were subjected to liver function tests, ultrasonogram on fourteenth postoperative day. Similarly, T tube cholangiogram was done on patients who had T tube in situ on the 8th- 10th post operative day. All patients underwent magnetic resonance cholangio pancreatogram after twelve weeks to rule out any residual stone. All patients were regularly followed for a period of six months for clinical evidence of jaundice

RESULTS

In this prospective analysis of forty four patients, transcystic choledochoscopy was done in 4 patients (9.09%) and transcholedochotomy with choledochoscopy in 40 patients (90.91%). Of these one patient showed retained stone in magnetic resonance cholangio pancreatogram which was done postoperatively after twelve weeks. Figure2 depicts the route of choledochoscopy.

The failure rate of choledochoscopy accounted to 2.27%. The incidence of retained stone was comparatively lower in the study and it was comparable to international standard.

EPIDEMIOLOGY

The patients were compared based on the age, sex, length of hospital stay and history and symptomatology.

Age group

The commonest age group in the study was between 51-60years. Age group ranges from 21 years to 65 years. The male, female ratio according to age wise distribution is given in Figure 3

Sex incidence

The commonest gender affected by choledocholithiasis was female (26 patients) accounting to 59.1% totally and males accounted for 18patients (40.9%) which is shown in Figure 4

Figure1

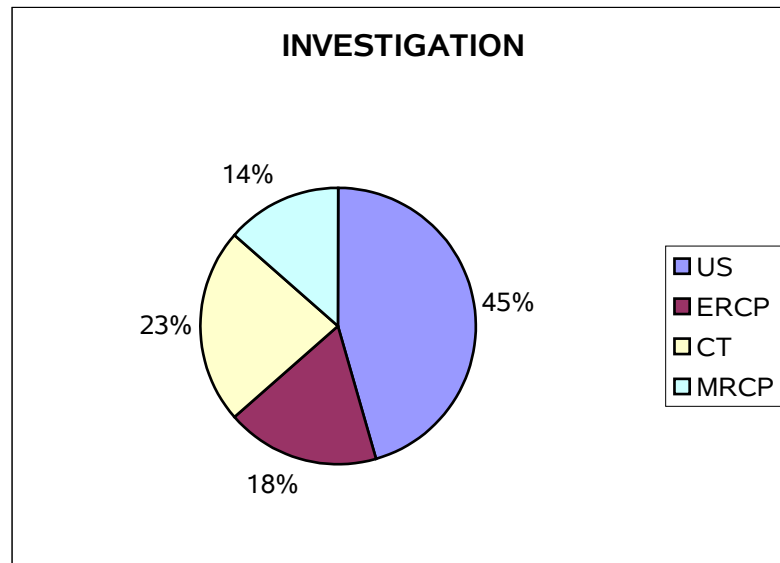


Figure 2

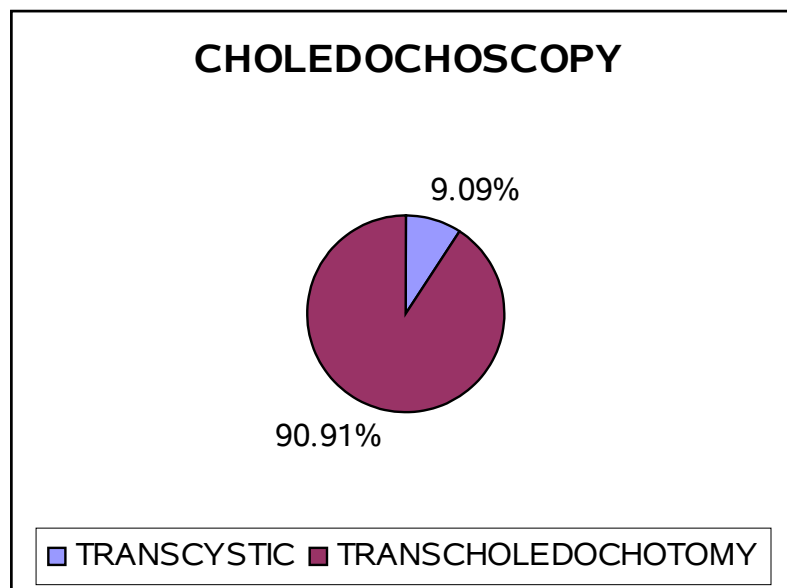


Figure 3

AGE GROUP

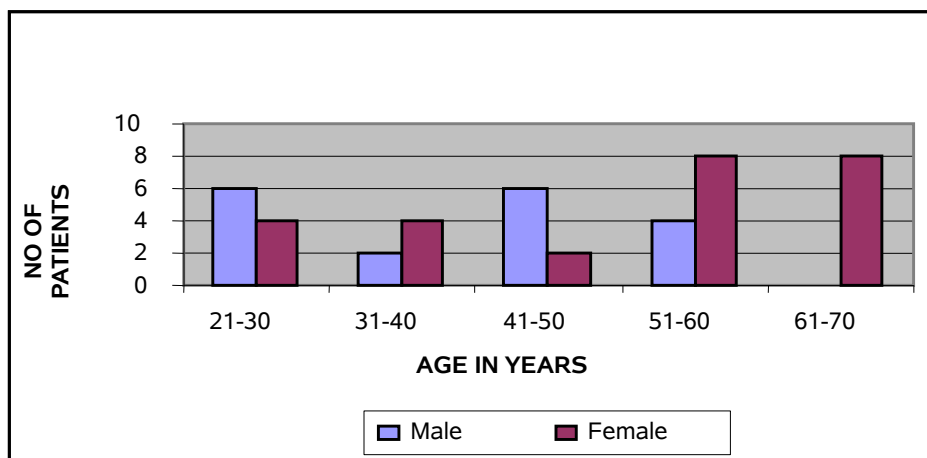


Figure 4

SEX INCIDENCE



Length of hospital stay

While comparing the total number of days each patient stayed in the hospital ,. it ranges from 13days to 64days. Average 30.5days / patient.

Complaints

The commonest complaint given by the patients was pain (81.8%) and jaundice (81.8%). The other symptoms include vomiting (50%), fever (40.9%) past history of jaundice, clay coloured stools, pruritis (36.36%) dyspepsia (18.18%), loss of appetite (13.63%), loss of weight (9.09%), flatulence (4.5%)

Table 1 depicts the complaints

Table 1

S.No	Complaints	Number of patients	%
1.	Pain	36	81.8%
2.	Jaundice	36	81.8%
3.	Vomiting	22	50%
4.	Fever	18	40.90%
5.	Pruritus	16	36.36%
6.	Clay coloured stools	16	36.36%
7.	Past H/o jaundice	16	36.36%
8.	Dyspepsia	8	18.18%

9.	Loss of appetite	6	13.63%
10	Loss of weight	4	9.09%
11	Flatulence	2	4.5%

Co-morbid illness

Out of forty four patients there were about ten patients who had co-morbid illness, such as diabetes mellitus in 4 patients (9%) and hypertension in 6 patients (13.63%)

History of Surgery

There was a past history of surgery in 14 patients (31.8%). The different types of surgery were cholecystectomy, duodenal perforation closure, puerperal sterilization, hysterectomy, truncal vagotomy with pyloroplasty, truncal vagotomy with gastro jejunostomy, cholecystectomy with choledochal cyst excision. The different types of surgery and endoscopic interventional procedures are depicted in Figure5

There was previous history of endoscopic procedure in 8 patients (18.18%), the details of which are given in Table2.

Table 2

S.No	Endoscopic Procedure	Number of patients
1.	ERCP & Sphincterotomy	2
2.	ERCP & Stenting	4
3.	ERCP, Sphincterotomy with Stenting	2

--	--	--

CLINICAL FEATURES

The commonest clinical features was jaundice (68.18%) followed by fever (40.9%), pruritus (27.27%), palpable liver (27.27), splenomegaly (4.54%), signs of liver failure (2.27%) and murphy’s sign (2.27%). The symptoms are depicted in Figure 6

On per rectal examination twenty eight patients (63.64%) had yellow coloured stools and 16 patients (36.36%) had clay coloured stools.

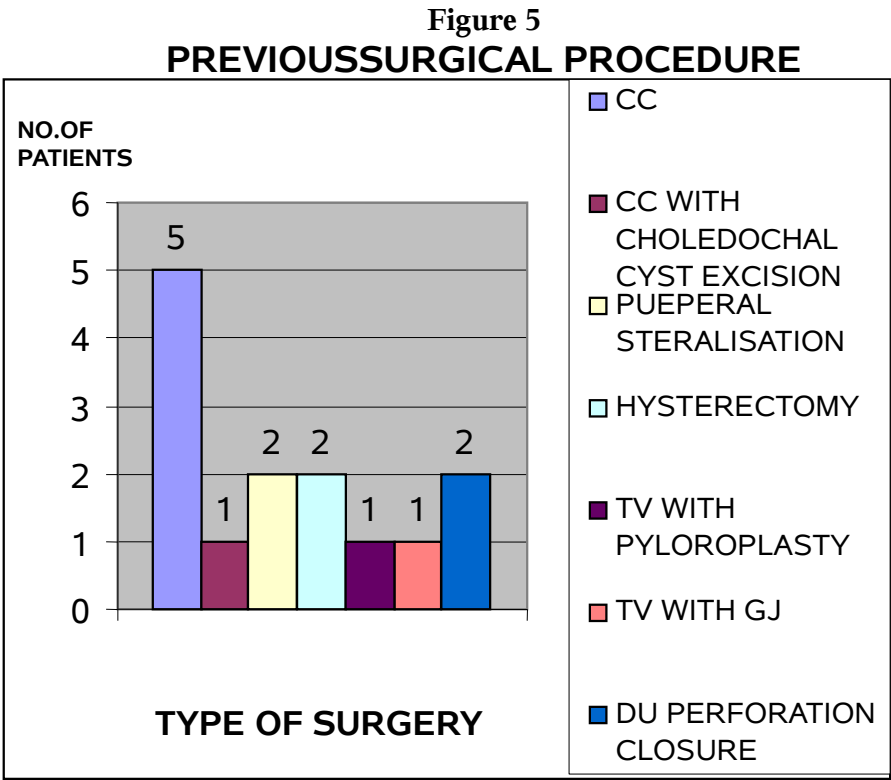
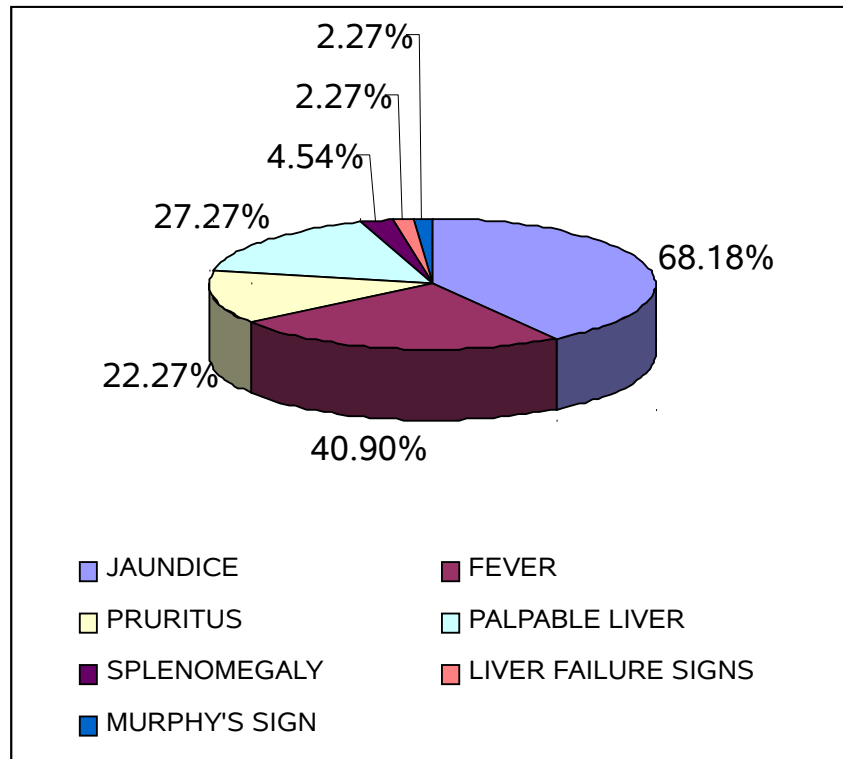


Figure 6
CLINICAL FEATURES



INVESTIGATIONS

Preoperative investigations done were complete blood count, serum liver function tests, urine for bile salt and bile pigment, BT, CT, PT, APTT, INR, Serum Amylase, ultrasound, computerized tomography, MRCP (selected patients) and UGI Scopy. The numbers of patients showing abnormal values are depicted in Table 3

Table 3

S.No	Investigation	Number of patients with abnormal value	% of abnormality
1.	Complete Hemogram	-	0%
2.	Serum Bilurubin (>2mg %)	30	68.18%

3.	SGOT (>40 IU/dl)	10	22.72%
4.	SGPT (>4IU/dl)	10	22.72%
5.	Serum Alkaline phosphatase (36-141Mu/ml)	22	50%
6.	Urine bile salt and pigment positive	30	68.18%

The UGI scopy was done in all patients and was found to be abnormal in 12 of them (27.27%). Findings are given below in Figure7.

Hence endoscopy should be done preoperatively to exclude other causes of mass in the epigastrium.

SURGICAL PROCEDURE AND OPERATIVE FINDINGS

Of the forty four patients, 38 of them (86.36%) underwent cholecystectomy. The remaining 6 patients had already undergone cholecystectomy. Cholecystectomy was done by neck to fundus method in 18 patients and fundus to neck method in 20 patients. After cholecystectomy, choledochoscopy was done through choledochotomy route in 40 patients (90.91%) and through transcystic route in 4 patients (9.09%). .

Based on the diameter of the common bile duct, patients were subjected to surgical procedures. Those who had CBD diameter >15mm were treated with choledochoduodenostomy or choledochojejunostomy or primary closure. Those who had CBD diameter <15mm were treated with closure of CBD with T tube. The type of incision is given in the Figure 8

Right subcostal incision was the commonest incision used (68.18%). When the surgical procedures were compared, majority underwent choledochoduodenostomy

31patients(70.45%), T tube drainage in 6 patients(13.63) and primary closure of CBD in 6 patients (13.63%) and choledochojejunostomy was done in a patient(2.27%) who had excision for type 2 choledochal cyst with retained stone in the left hepatic duct. The type of operative procedure is given in Figure9.

When the operative findings were compared, it was found that out of 38 patients who underwent cholecystectomy, 12patients had cholelithiasis. Out of twelve patients there was single stone in gall bladder in 2 patients (4.54%) and multiple stones in the gall bladder in 10 patients (22.72%).

The common bile duct stone was single in 34 patients (77.27) and multiple in 10 patients (22.72%) . 12 patients (27.27%) showed both common bile duct and gall bladder stones. When the diameter of the common bile duct was analysed, it was found that the diameter ranged from 6mm to 25mm (average 17mm). There were 2 patients (4.55%) who had associated distal CBD stricture. Biopsy of the stricture was done, which confirmed only fibrous tissue.The operative findings are shown below in Figure 10

Figure 7

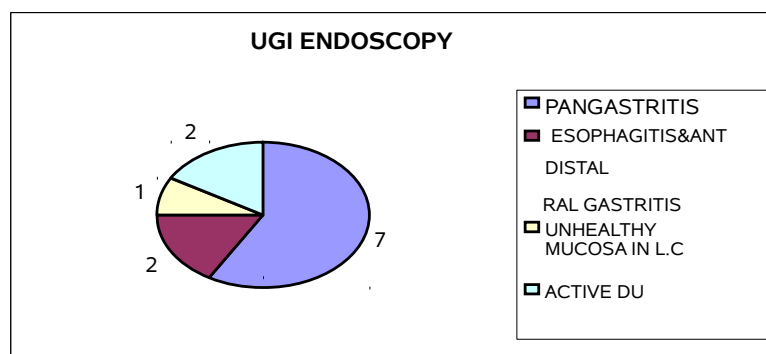


Figure 8

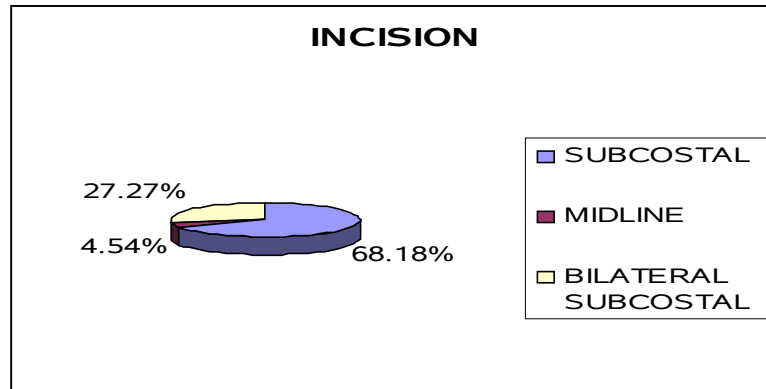
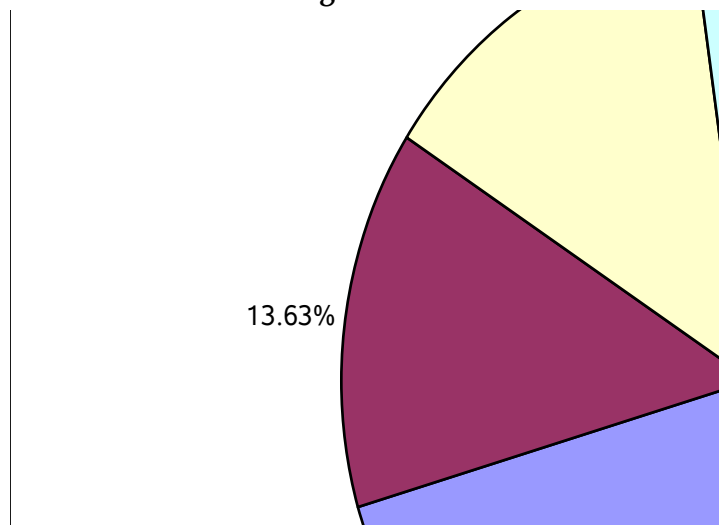


Figure 9



COMPLICATION

The commonest complication was wound infection in 14 patients (31.81%). The other complications were bile leak in 2 patients (4.55%), retained stone in one patient (2.27%), who had choledochal cyst excision for type 2 choledochal cyst. Figure 11 depicts the complication in detail.

Figure 10
OPERATIVE FINDINGS

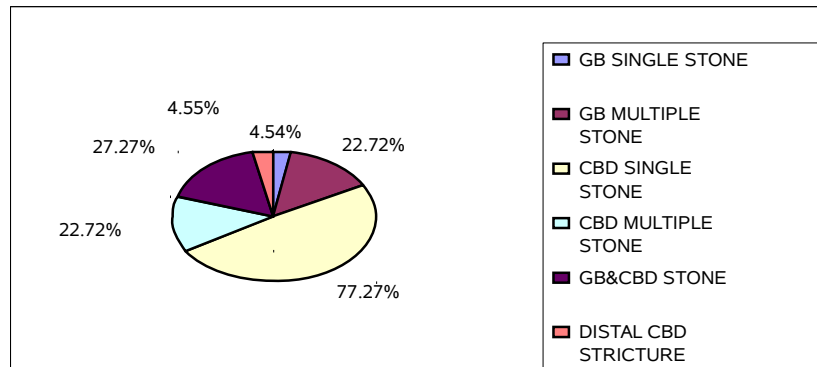
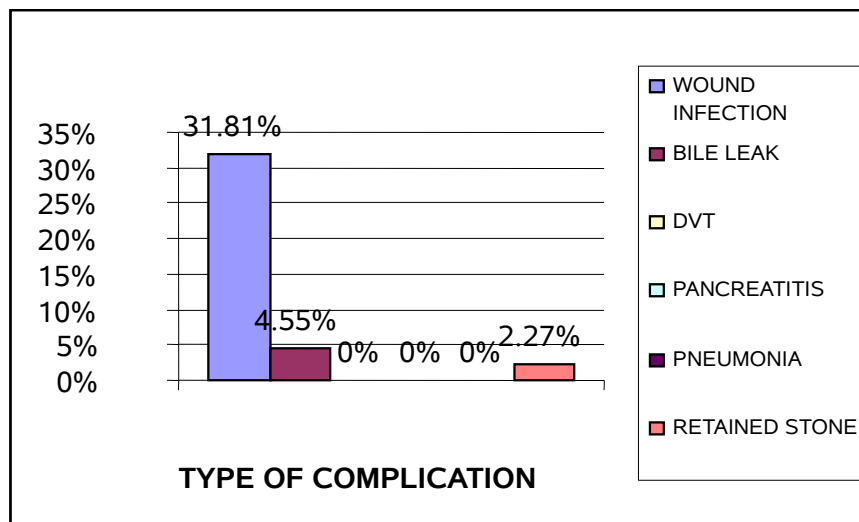


Figure 11
COMPLICATION



FOLLOW-UP

- Post operative follow up was done for a period of six months.
- 'T' tube cholangiogram was done in 6 patients (13.63%) on the 8th-10th post operative day. After confirming that no residual stone in the common bile duct and free flow of

dye into the duodenum, the T tube was removed on the 12th-14th post operative day and subsequently discharged.

- Serum liver function test was done on the 14th post operative day, which showed raised serum bilirubin (>2mg %) in eight patients that subsequently normalized on routine check – up.
- Postoperative high frequency ultrasound done on the 14th post operative day was normal in all patients.
- Patients were regularly followed up every fifteen days for six months
- Magnetic resonance cholangio pancreatogram was done in all patients on the completion of 12 weeks post operatively. One patient had retained stone in the left hepatic duct (2.27%). The particular patient already underwent choledochojejunostomy and subsequent follow up showed no retained stone.

DISCUSSION

(A) History

The wish and need to examine the biliary system directly dates from the beginning of surgery on the biliary system.

In 1941, Mac Iver ⁷ and copperstow described rigid choledochoscopic instrument equipped with a lens, a distal light source and a rinsing device.

In 1972, Morgenstern and Berci introduced a rigid choledochoscopy using a Hopkin's system.

In 1970, Olympus introduced the CHF series of choledochoscope with improved fiberoptics and maneuverability.

The flexible choledochoscope was first described by Shore and Lippman in 1965. (8) The flexible choledochoscopy was gradually improved and modified by Ashby to the present range, the CHF-20 series.

In 1974, Takada et al ⁹ tried percutaneous transhepatic cholangioscopy through percutaneous transhepatic biliary drainage tract.

In 1978, Nakajima ⁹ reported direct endoscopic visualization of biliary and pancreatic duct system by peroral cholangio pancreatoscopy.

In 1981, Nimura et al ⁹ reported percutaneous transhepatic cholangioscopy. In 1981, Ishikawa ⁹ et al developed percutaneous transhepatic cholecystography.

In 1994, Soda et al ⁹ reported a new type of small caliber flexible scope (miniscope) that can be introduced into bile duct through normal papillae of vater, allowing the duct to be inspected noninvasively.

Nevertheless large or impacted stones remained problematic. Technical advances led to techniques that are both safe and effective, including the application of laser in 1981 ¹⁰ and choledochoscopic electro hydraulic shockwave lithotripsy (ESWL in 1985) ¹¹. Treatment of choledocholithiasis via a T tube tract including dissolution therapy of various types and extraction under fluoroscopic control using a steerable catheter as introduced by Burhenne ¹².

In recent era, laparoscopic cholecystectomy eliminated the approach route to CBD by which choledochoscopy, can be performed in suspected CBD stone during or after removal of gall bladder. Laparoscopic choledochoscopy has been performed using small diameter fiberoptic instrument ¹³.

(B) INSTRUMENTS

The choledochoscope commonly used in surgical practice may be rigid or flexible type. In our series we used flexible choledochoscopy ¹⁴ (Type PENTAX FCN-15X), Which is shown in figure(12).

The instrument has been improved considerably in recent years with advances in fiberoptics and miniaturization.

The instrument consists of a small control unit which houses the eye piece and a lever to control angulation of the tip. The working shaft has a length of 40cm with graduated flexibility, being more rigid proximally to facilitate control of the tip. The tip angulation ranges to maximum 290°. Flexible choledochoscope has increased access to the intra hepatic bile duct up to 2 or 3 subdivisions and used to visualize the ampulla without mobilization of the duodenum. Instruments can be passed through the irrigation channel.

ACCESSORY EQUIPMENTS

Accessory equipments available for diagnostic and therapeutic procedures include

1. Dormia basket for stone removal
2. Biopsy forceps for choledochoscopic biopsy
3. Guide wire to guide insertion of catheter balloons
4. Electro hydraulic lithotripsy (EHL) shock wave generator and EHL probe
5. Injection needle used for tumour ablation
6. ND Yag laser equipment and a laser fiber probe.
7. Transductal manometry devices.
8. Balloons & inflation devices
9. Irrigation catheter
10. Quadrangular basket forceps
11. Double jointed stone dislodger

(C) APPROACHES TO THE BILE DUCTS

Flexible fiberoptic choledochoscope can reach stones in the bile duct via several different approaches. These can be either surgical or non surgical (minimally invasive) ¹⁵. The minimally invasive route include a percutaneous transhepatic tract after percutaneous transhepatic biliary drainage (PTBD) ¹⁶, T tube tract ¹⁷, jejunostomy tract ¹⁸, cholecystostomy tract ¹⁹, peroral cholangioscopy and pancreatoscopy.

The different types of approaches are

1. Percutaneous transhepatic cholangioscopy
2. Percutaneous transhepatic cholecystoscopy
3. Operative choledochoscopy

4. Postoperative choledochoscopy
5. T. tube tract choledochoscopy
6. Jejunostomy tract choledochoscopy
7. Cystic duct choledochoscopy

The commonest approach followed is operative choledochoscopy. In operative choledochoscopy, choledochoscope is introduced directly in to the bile duct during laparotomy. It is usually performed as a method of exploration of bile duct in patients with dilated duct due to choledocholithiasis to remove stones or to confirm the absence of residual stones.

FINDINGS AT OPERATIVE MANEUVER

Normal mucous membrane of CBD is pale pink in appearance with a faint yellow tinge. There are usually several longitudinal folds present, which are flattened by the presence of the irrigating fluid. Approaching the ampulla, the duct narrows, becomes funnel shaped and curves forward right posteriorly. Distal sphincter area usually appears stellate but may look some what fish mouthed, pin point or patulous in nature. The mucosa of the hepatic ducts is paler than of distal duct.

In cholangitis the appearance range from mucosal congestion and edema to marked ulcerative cholangitis with fibrinous exudates. These inflammatory changes can be marked in papillary region. CBD stone are easily identified as free floating or found impacted in the orifice of ampulla or partially embedded in the ductal wall or in a diverticulum of the distal duct. Multiple stones and biliary mud are frequently found behind the larger calculus.

If the stone is visualized , the irrigation should be decreased or stopped to avoid pushing the stone further distally or in case of hepatic calculus proximally. Small calculi can

be flushed into duodenum, in some cases under visual control using warm saline. For larger calculi, the assistant advances the stone basket and with co-ordinated movements, the calculus is entrapped. The cholangioscopic view of bile duct and stone is given in figure(13,14,15,16 & 17)

Figure 11

CHOLEDOCHOSCOPE

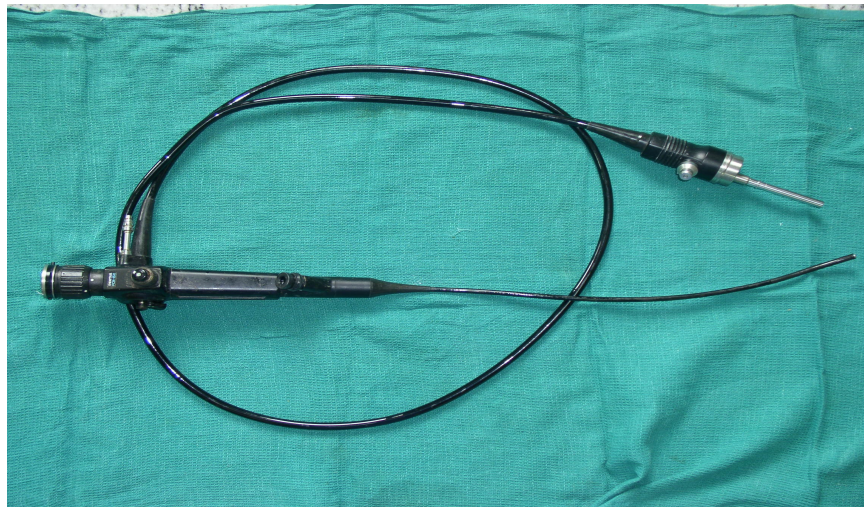


Figure 12

INTRAOPERATIVE CHOLEDOCHOSCOPE



Figure 13

CHOLEDOCHOSCOPIC VIEW OF NORMAL EXTRAHEPATIC DUCT

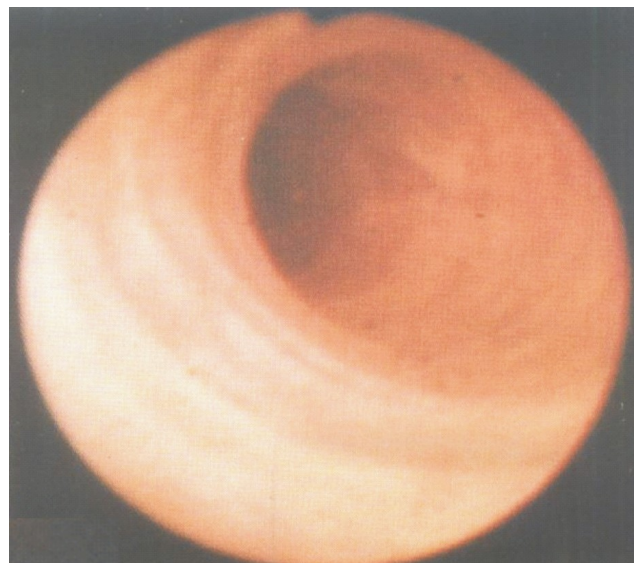
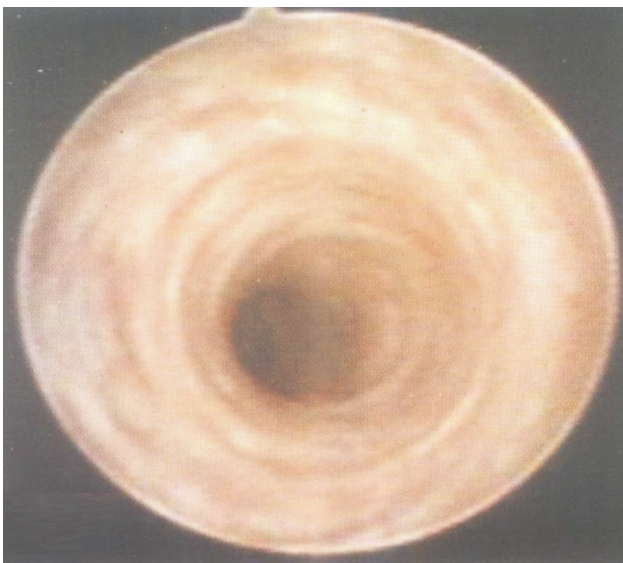


Figure 14

CHOLEDOCHOSCOPIC VIEW OF NORMAL INTRAHEPATIC DUCT

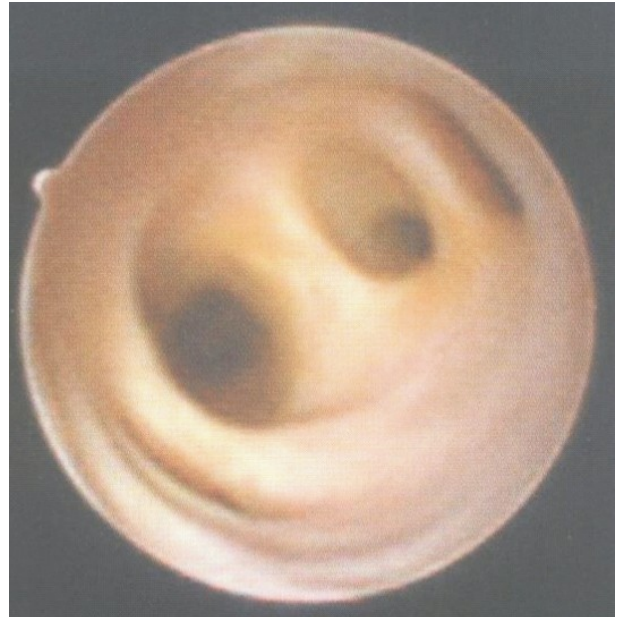


Figure 15

CHOLEDOCHOSCOPIC VIEW OF CBD STONE

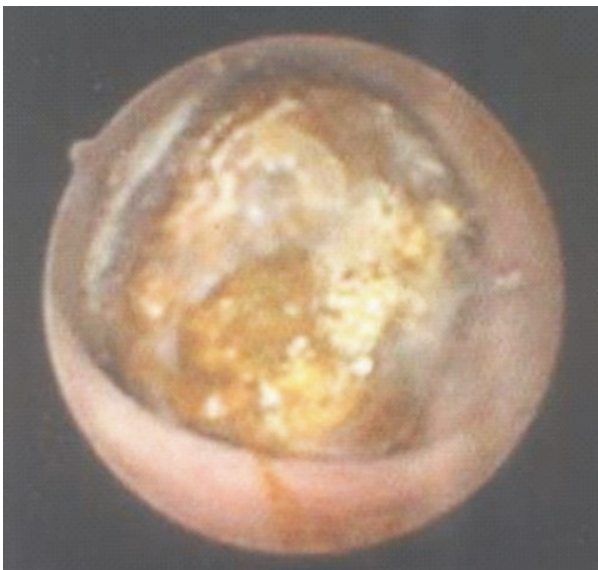


Figure 16

CHOLEDOCHOSCOPIC VIEW OF INTRAHEPATIC STONE

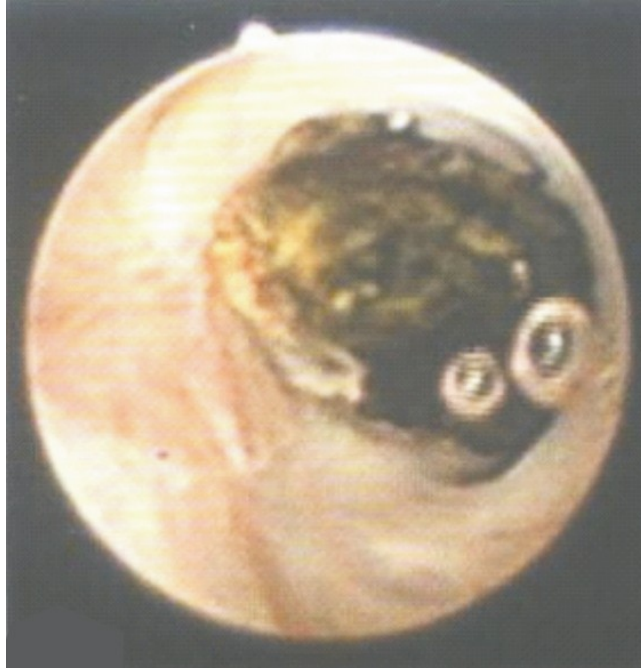
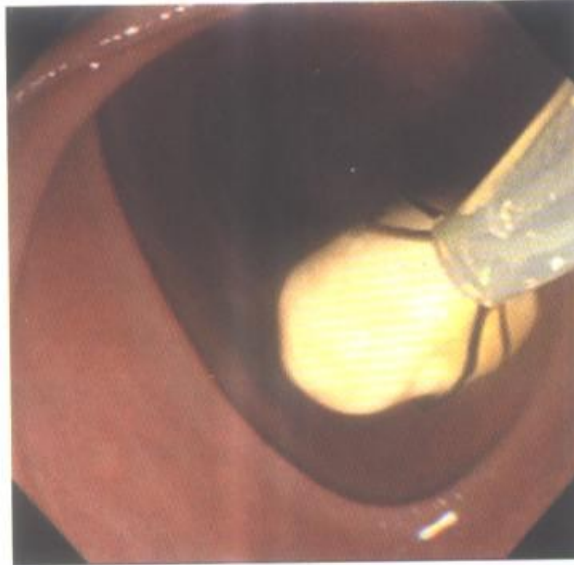


Figure 17

RETRIEVAL OF STONE USING DORMIA BASKET



COMPARISON OF CONVENTIONAL EXPLORATION OF CBD WITHOUT CHOLEDOCHOSCOPY AND WITH CHOLEDOCHOSCOPY

In most series reviewed , stones that are found within the biliary tree after conventional exploration are regarded as retained stones. Retained stones should be expressed as a percentage of the number of stone-positive explorations and should not be related to the total number of common bile duct explorations. The percentage incidence of retained stones is therefore been related to number of stone – positive explorations at which the choledochoscope was used.

Few series are now reported on the results of exploration of the common bile duct where instrumentation alone is carried out and not followed by choledochoscopy (Table 4) ²⁰.

The mean incidence of retained stones is 10.6% (median 10.0 percent)

Table 4

RESULTS OF CONVENTIONAL EXPLORATION OF COMMON BILE DULT

S.No	Reference	Year	Stone positive exploration	No retained stones	% of retained stones
1 .	Isaccs & Davies	1960	NA	NA	5
2 .	Way et al	1972	NA	NA	10
3 .	Le. Quesne et al	1975	78	1	1.3
4 .	Stubbs & Blumgart	1984	23	3	13
5 .	Gartell & Mc Ginn	1984	32	6	18.7
6 .	Rogers et al	1985	55	7	12.7
7 .	Jakimowicz et al	1986	40	3	7.5

8	Neoptolemos et al	1987	59	5	8.5
9	Sheridan et al	1987	191	37	19.4
Total					10.6

With the use of rigid choledochoscope, the incidence of retained stone is lower with a mean incidence of 3.6 percent. (Median 3.3percent).The use of flexible choledochoscope offers greater versatility and maneuverability allowing a more complete exploration of the duct. When the published data are analysed the mean retained stone rate of 2.0 percent (Median 1.85%) is lower than that achieved with either conventional exploration or rigid choledochoscopy (Table 5) ²⁰.

Table 5

RESULTS OF FLEXIBLE CHOLEDOCHOSCOPY

S.No	Reference	Year	Stone positive exploration	No. retained stone	% of retained stone
1 .	Shore and shore	1970	100	4	4.0
2 .	Long land	1975	49	2	4.1
3 .	Stotter et al	1975	20	0	0
4 .	Finnis&Rowntree	1977	70	0	0
5 .	Legrand et al	1978	200	4	2.0
6 .	Yap et al	1980	84	4	4.8
7 .	Bauer et al	1981	36	1	2.8
8 .	Grange&Millard	1981	47	0	0
9 .	Wang	1982	47	1	2.1
1 0	Chen et al	1983	184	2	1.1

1 1 .	Gartell& McGinn	1984	31	1	3.2
1 2 .	Leggeri at al	1984	128	2	1.6
1 3 .	Ashby	1984	65	1	1.5
1 4 .	May & Corfield	1985	33	3	9.0
1 5 .	Eleftheriadis et al	1985	88	0	0
1 6 .	Ashby	1985	70	1	1.4
1 7 .	Jakimowicz et al	1985	26	0	0
1 8 .	Jakimowicz et al	1986	238	5	2.1
1	Choi et al	1987	65	3	4.6

2 0 .	Markowitz et al	1987	102	0	0
2 1 .	Molina et al	1988	36	1	2.8
Total			1719	35	2.0

(D) CHOLEDOCHOLITHIASIS

In era of open cholecystectomy the common bile duct was explored in approximately 15% of all cholecystectomies and stones were removed in approximately 65% of these explorations. The incidence of concomitant choledocholithiasis varied between 8 and 20% (Table 6) ²¹.

Table 6

INCIDENCE OF CHOLEDOCHOLITHIASIS IN PATIENTS WITH GALL STONES

S.No	Reference	Total cases of gall stones	Exploration of CBD %	Exploration Yield stone %	Overall incidence of CBD % stone
1	Mcsherry & Glenn (1980)	8791	15.5	60	9.5
.					
2	Hampson et al (1981)	2889	15	51	8
.					
3	Doyle at al (1982)	4000	22	52.5	11.5
.					
4	Lygidakis (1983)	3710	11.5	80	9.5
.					
5	Coelho et al (1984)	908	21	72	15
.					

6	Ganey et al (1986)	1024	26	36	9.5
.					
7	Denbesten & Berci (1986)	983	24.5	81	20
.					
8	R.M.Girard (1986)	10471	11	75	8
.					
Total		32776	15	63	9.5

Types of choledocholithiasis

The stones in common bile duct may be primary or secondary which vary in epidemiology. Majority of CBD stones are secondary stones which originally form in the gall bladder and later pass down through the cystic duct into CBD. The size of secondary bile duct stone is limited by the diameter of the cystic duct, and thus these stones are significantly smaller than primary stone.

The incidence of primary CBD stone is controversial and varies from 4% to 56% ²² Madden defined primary stones as solitary, ovoid, light brown in color, soft and easily crushable. Saharia et al ²³ classified patients as having primary stones if they met all of the following criteria.

1. Previous cholecystectomy with or without common bile duct exploration
2. Atleast two year asymptomatic period after initial biliary tract surgery.
3. Presence of soft friable, light brown stones or sludge in the common duct
4. Absence of long cystic duct or biliary stricture due to previous surgery.

Pathogenesis of choledocholithiasis

The stones in the common bile duct may be cholesterol or pigment stones. The pigment stone may be black or brown stones. The characteristics of the different types of CBD stone is given in Table 7

Table 7**CHARACTERISTICS OF CBD STONE**

S.No	Characteristics	Brown pigment stone	Black pigment stone	Cholesterol stone
1 .	Color	Earthy, muddy, chocolate	Black, dark (Yellow core)	White, yellow Beige, tan
2 .	Consistency	Soft, amorphous	Hard	Hard
3 .	Surface	Dull	Smooth, Shiny	Smooth, Shiny
4 .	Inner structure	Laminated	Amorphous	Radial, crystalline
5 .	Cholesterol content	<20%	<20%	70-100%
6 .	Calcium Bilirubinate	10-60%	10-60%	<10%
7 .	Chemical content	Calcium palmitate	Calcium carbonate (or) phosphate	Cholesterol
8 .	Bacteria	Common	Infrequent	Rare

--	--	--	--	--

The secondary CBD stone arise in gall bladder and migrate to CBD and have a spectrum of cholesterol stone and black pigment stone. Black pigment stones occur in condition in which bilirubin excretion is increased as in haemolytic disorders, and in situation associated with profound gall bladder stasis such as prolonged fasting and long term parental nutrition, cirrhosis and ileal disease.

Brown pigment stone are primary CBD stone. The cause of brown stone is biliary stasis secondary to factors such as sphincter of oddi dysfunction, benign biliary strictures, sclerosing cholangitis and cystic duct dilatation and infestation with *Ascaris lumbricoides* and *Clonorchis sinensis*.

PATHOPHYSIOLOGY OF BILIARY TRACT OBSTRUCTION

Obstruction of biliary tract in one of its many forms is a problem frequently encountered by the general surgeons. Pathophysiological effects of biliary tract obstruction is classified into four sub divisions

1. Physical effect
2. Pathological effect
3. Biochemical effect
4. Other functional effect

1. Physical effect

(a) Secretion ceases when biliary pressure exceeds 300mm of H₂O.²⁴ Cholesterol and phospholipid secretion are more readily reduced by high pressure than bile salt secretion, so that composition of hepatic bile is altered and becomes less lithogenic²⁵. High biliary

pressure causes bacterial reflux into lymphatic and venous system .

(b) Hepatic blood flow might be reduced in the face of increasing hydrostatic pressure within the liver .

(c) Pain in biliary obstruction is due to distension of gall bladder or bile duct or may be associated with stretching of the liver capsule

2. Pathological effects

(a) Bile duct and canaliculi

Bile canaliculi become dilated and microvilli distorted and swollen. Bile pigment “thrombi” may be seen in the canaliculi and in the adjacent hepatocytes. Marked inflammatory reaction in the portal tract with a polymorphonuclear leukocyte infiltration (acute cholangiolitis) This cholangiolytic changes are followed by increased fibrogenesis with deposits of reticulin fibers and eventually of collagen bundle..

(b) Fibrotic changes

The reticulin laid down in periportal areas matures to type I collagen, causing scarring fibrosis around the bile ducts, which may further aggravate the cholestasis.

(c) Cholangitis

Acute cholangitis in its most severe form is a life threatening infection originating in the biliary tree. In early stage of obstruction, normal hepatic bile secretion continues and an increase in intra ductal pressure approach the secretory pressure of bile 25-30cm H₂O ²⁶ Normally the biliary tree is sterile due to continuous flow of bile. At biliary pressure greater than 15cm H₂O there is systemic reflux of radio labeled biliary bacteria ²⁶. The reticulo-endothelial system within the liver normally kills the vast majority of bacteria that enter the liver, with an estimated 10% entering the systemic circulation. Exact mechanism of bacteremia is unknown.

In addition, systemic release of inflammatory mediators such as endotoxin, interleukin-1 and interleukin-6 can produce profound hemodynamic effects in the toxic form of cholangitis. The systemic signs of cholangitis are caused by bacterial toxin and inflammatory mediators released via cholangio lymphatics or cholangio venous pathways.

In presence of gall stones either within the gall bladder or biliary tree, positive culture are seen in 15-50% and 70-90% respectively ²⁷. In complete ductal obstruction secondary to malignancy 25-40% of patients have positive cultures.

The organisms most often isolated are gram negative aerobe, *Escherichia coli* and *Klebsiella pneumoniae*, the gram positive enterococci and gram negative anaerobe, *Bacteroides fragilis*. In 30-50% of patients more than two organisms are present. It was also shown that $>10^5$ organism are seen in

1. 0% of normal patients
2. 3% of patients with symptomatic gall stones.
3. 36% of patients with common duct stones but without cholangitis
4. 85% of patients with acute cholangitis ²⁸.

(D) Atrophy

Long standing obstruction of biliary tract leads to atrophy of liver

(iii) Biochemical effect:

The following bio-chemical changes are expected to occur in biliary obstruction due to choledocholithiasis

(a) Bilirubin: With complete biliary out flow obstruction serum total bilirubin levels typically increase by 25-43 $\mu\text{mol/L/day}$ ²⁹.

(b) Alkaline phosphatase: Elevation of this enzyme is sensitive indicator of biliary tract obstruction.³⁰ Other large molecular size isoenzyme which appears in cholestasis and attached to circulating membrane fragments are 5' nucleotidase, gamma glutamyl transpeptidase and lipoprotein X.

(c) **Lipids:** Cholesterol levels may be elevated in long standing biliary obstruction. .

(e) **Carbohydrate metabolism**

Abnormal glucose tolerance may be seen in patients with impaired liver function and impaired gluconeogenesis after prolonged bile duct obstruction

(f) **Bile salt circulation**

Increased serum bile acid level up to sixty times normal due to interruption of entero hepatic circulation of bile salt occurs due to total biliary tract obstruction.

(IV) Other functional effects:

(a) **Endotoxemia**

In obstructive jaundice endotoxin has been found in the peripheral circulation in up to 50% of patients ³¹ with bile duct obstruction and play a central role in pathophysiology.

(b) **Immunological effect**

Extra hepatic biliary obstruction results in cellular immune dysfunction due to depression of T cell function due to direct effect of systemic endotoxemia

HISTORY/ CLINICAL FEATURES

Choledocholithiasis cannot be diagnosed reliably on the basis of symptoms or physical examination. The natural history of choledocholithiasis is unpredictable. Patient with choledocholithiasis may be completely asymptomatic. In approximately 7% of cases, the stones are found incidentally during cholecystectomy. Approximately 25-50% of symptomatic CBD stones eventually cause symptoms and require treatment. Symptoms

occur when the stones obstruct the common bile duct. The clinical presentation varies depending on the degree and level of obstruction and the presence or absence of biliary infection. Choledocholithiasis occur in any of the following five ways.

1. Without symptoms
2. Biliary colic
3. Jaundice
4. Cholangitis
5. Pancreatitis

- Although intermittent right upper quadrant post prandial pain, nausea, vomiting, bloating, fatty food intolerance are often perceived to be symptoms of biliary tract disease, they are not specific.
- The classic charcot's triad which includes fever with chills, jaundice and pain indicates cholangitis
- When the triad is associated with hypotension and mental confusion (Reynolds pentad)³²
- Pain is the most frequent presenting symptom.
- Fever is an indication of cholangitis and classic charcot's triad strongly favour the diagnosis. A recent study showed fever in (92%); jaundice in (65%); pain in (42%) & all three symptoms in (19%) of patients
- Jaundice occurs when CBD becomes obstructed and conjugated bilirubin enters the blood stream. History of clay coloured stools and tea coloured urine is obtained in approximately 50% of cases.
- Gallstones are responsible for 50% of all cases of pancreatitis ,conversely 4-8% of

patient with gall stone develop Pancreatitis.

- Pancreatitis pain is different from biliary pain. Pain is located in the epigastric and mid abdominal areas and is sharp, severe, continuous and radiated to back.
- History of benign CBD strictures, sclerosing cholangitis, sphincter of oddi dysfunction and cystic dilatation of CBD are important in the diagnosis of biliary stone.
- Parasitic infestation with *A. lumbricoides* or *C. Sinensis* may result in development of primary CBD stone
- Acute cholecystitis should be suspected when there is right upper quadrant pain and tenderness on deep inspiration (Murphy's sign).
- Chronic cholecystitis should be suspected when gall bladder is not palpable and Courvoisier's law is satisfied which states that "when CBD is obstructed by a stone, dilatation of gall bladder is rare; when the duct is obstructed in some other way, the dilatation is common"
- Signs of liver failure with palpable liver and spleen may be an associated finding.

INVESTIGATIONS

Laboratory tests are helpful, but the results are not specific for the diagnosis of choledocholithiasis. Patients with cholangitis and pancreatitis have abnormal laboratory test values. Single abnormal laboratory value does not confirm the diagnosis of choledocholithiasis, cholangitis or pancreatitis rather a coherent set of laboratory studies lead to correct diagnosis

1. White blood cell count elevation indicates the presence of infection or inflammation. Elevation above $10,000/\text{mm}^3$ was significant. In our study all cases showed WBC count $<10,000/\text{mm}^3$.
2. Serum bilirubin level elevation indicates obstruction of the CBD. Serum Bilirubin more than 2mg/dl is considered abnormal. In our study thirty patients (68.18%) had increased values, out of which 4 patients had values greater than 10mg / dl .
3. Liver transaminase levels are elevated in choledocholithiasis. Increased transaminase level was present in ten patients (22.72%) in our study.
4. Serum alkaline phosphatase levels are elevated in patients with obstructive choledocholithiasis. Normal value is $36-141\text{mu / ml}$. Increased serum alkaline phosphatase level was present in twenty two patients (50%).
5. Serum gamma glutamyl transpeptidase and 5' nucleotidase levels are elevated in patients with obstructive choledocholithiasis. Normal serum GGT level is $<55\text{u/l}$.
6. Serum protein levels may be abnormal in severe liver dysfunction associated with obstructive choledocholithiasis.
7. Coagulation profile

8. Bleeding time, coagulation time may be abnormal in long standing obstructive jaundice . Prothrombin time may be elevated in patients with prolonged CBD obstruction, secondary to depletion of vit-k . Bleeding time was normal in all patients. Coagulation time and prothrombin time was abnormal in one patient who had ascitis with pleural effusion. Activated partial thromboplastin time (APPT). APPT was abnormal in one patient which was normalized after fresh frozen plasma transfusion.
9. Serum Amylase and lipase values are elevated in presence of acute pancreatitis complicating choledocholithiasis
10. Serum electrolytes value are important in correcting electrolyte imbalance in patients with obstructive jaundice
11. Urine bile salts and bile pigments positivity indicates jaundice and were routinely done as a work up for jaundice. In our study only 30 patients (68.18%) had urine bile salt and bile pigment positivity

IMAGING STUDIES

Imaging studies done in patient with choledocholithiasis are grouped as

1. PREOPERATIVE STUDIES

- (a) NON INTERVENTIONAL
 - Trans abdominal ultrasound
 - Endoscopic ultrasound
 - Computerized tomography
 - Magnetic resonance Cholangio pancreatography
 - Upper Gastro intestinal Endoscopy
- (b) INTERVENTIONAL
 - Endoscopic Retrograde cholangio pancreatogram
 - Percutaneous transhepatic cholangiogram

2. INTRA OPERATIVE STUDIES

- Choledochoscopy
- Cholangiography
- Intra operative ultrasound

3. POST OPERATIVE STUDIES

- T tube cholangiography
- Trans abdominal ultrasound
- Magnetic resonance cholangio pancreatography

PREOPERATIVE STUDIES

(1) Trans abdominal ultrasound

Ultrasonogram has been always the first imaging study for jaundiced patients. Dilated bile ducts are seen as tubules lying along side the portal vein branches. This pattern is characteristic and specific .

The level of obstruction can be predicted accurately in 80% of cases. The demonstration of stones in CBD depends on their size and position. Larger stones (>5mm) are readily visualized unless excessive intestinal gas precludes adequate imaging

Ultrasonography is accurate in the diagnosis of all gallbladder stones (97% in elective situation and 80% in presence of acute cholecystitis). But common bile duct stones are missed frequently (sensitivity 15-40%). The detection of CBD stone is impeded by presence of gas in duodenum. CBD dilatation is identified accurately with up to 90% accuracy. Recent advance with the introduction of tissue harmonic imaging (THI) gives better visualization of fluid filled structure and reduced artifacts and enhanced contrast resolution.

In our study, ultrasound was done in all patients. Out of forty four patients, twenty patients (45%) were diagnosed by ultrasound to have choledocholithiasis. Figure.18 shows U/S finding in choledocholithiasis.

(2) Endoscopic ultrasound

Though our institution lacks the specific investigation it needs special mention. Two types of echo endoscope are available for the examination of biliary tree.

1. Mechanically rotating transducer
2. Electronic rotating transducer

The availability of high frequency catheter based ultrasound probes has made it possible to obtain ultrasound images within the biliary tree. Normal bile duct can be imaged as three layered structure.

1. Inner hyperechoic layer represents mucosa with a border echo.
2. Middle hypoechoic layer represents the smooth muscle fiber and fibro elastic tissue.
+--
3. Outer hyperechoic layer represents thin and loose connective tissue with a border echo ³³

EUS sensitivity and specificity of CBD stone detection are reported in the range of 84% to 100% and 95% to 100% respectively.

(3) Computerized tomography

CT scan is very accurate in detection of biliary tree obstruction and ductal dilatation, both intrahepatic and extrahepatic. The insensitivity of sonography in detecting choledocholithiasis has been well documented with a reported detection rate of 18 to 22%. CT has much higher sensitivity with a reported detection rate up to 76% ³⁴. Thin collimation scan (3 to 5mm) should be performed at close intervals through the transition area of the duct in order to detect the calculus. The only reliable indicator of choledocholithiasis is said to be the presence of dense intraluminal calcification or a “target sign” within the duct. CT is of little value when the stones are small and non calcified and bile duct dilatation is minimal or absent. Figure 19 shows CT Findings in choledocholithiasis.

(4) Magnetic resonance cholangio pancreato graphy

MRCP was used in six patients (14%) preoperatively and in all patients post operatively after 3months to detect CBD stones.

“MR Cholangio pancreatography” refers to a range of techniques for imaging the biliary tree and pancreatic duct that all exploit the intrinsically long T2 relaxation value of many fluids, including biliary and pancreatic duct secretions. The techniques may be classified by the MR “refocussing” method used (i.e. gradient echo or spin echo), image data collection (i.e. 2D or 3D), requirement for image processing to suppress background tissues, type of receiver coil and the approach used to minimize motion related artifacts ,those related to respiration.

Early attempts to image the biliary and pancreatic ducts used gradient echo method with body receiver coils. More recently, spin echo refocussed methods based on RARE (rapid acquisition with relaxation enhancement) ³⁵ and its variants combined with specialized surface receiver coils have permitted notable improvements in image quality and faster image acquisition. Most techniques have included image post processing, such as MIP (maximum intensity projection) algorithm.

Although the earlier gradient echo technique could detect the presence of biliary obstruction in 100% ^{36,37} and its level up to 90% ³⁷, they could not be used to determine accurately the underlying cause of obstruction. Improved results were achieved with RARE based technique.

MRCP is made possible by stationary fluid in the ducts producing high intensity signal. The images constructed can be cross sectional (tomographic) to visualize the bile duct as well as surrounding structures or projectional (cholangiographic) which produces image similar to cholangiogram. Figure 20 and 21 MRCP finding in choledocholithiasis.

The review of literature regarding sensitivity (SE), specificity (SP), diagnostic accuracy (DA), positive predictive value (PPV) and negative predictive value in the diagnosis of choledocholithiasis with MRCP is given in Table 7 ³⁸

Table 7

S.No	Authors	N	SE (%)	SP (%)	DA(%)	PP(%)	NPV (%)
1	Calvo et al (2002)	116	91	84	90	89	88
.							
2	Huassein et al (2002)	50	95	96	96	95	96
.							
3	Boraschi et al (2002)	95	90	96	94	95	93
.							
4	Stiris et al (2000)	50	87.5	94.4	90.0	96.6	81.1
.							
5	Lomas et al (1999)	69	100	97	-	82	100
.							
6	Pavone et al (1999)	189	90.2	98.5	96.3	95.8	96.4
.							
7	Little et al (1999)	104	81	100	94	-	-
.							

8	Lomanto et al (1997)	62	91.6	100	96.8	-	-
.							

Stones < 4mm can be imaged routinely even with MIP techniques and the sensitivity may be improved by reviewing the source image, or performing projection RARE sequences.

Figure 18

ULTRASOUND FINDING IN CHOLEDOCHOLITHIASIS



Figure 19

CT FINDING IN CHOLEDOCHOLITHIASIS



Figure 20

MRCP FINDING IN CHOLEDOCHOLITHIASIS

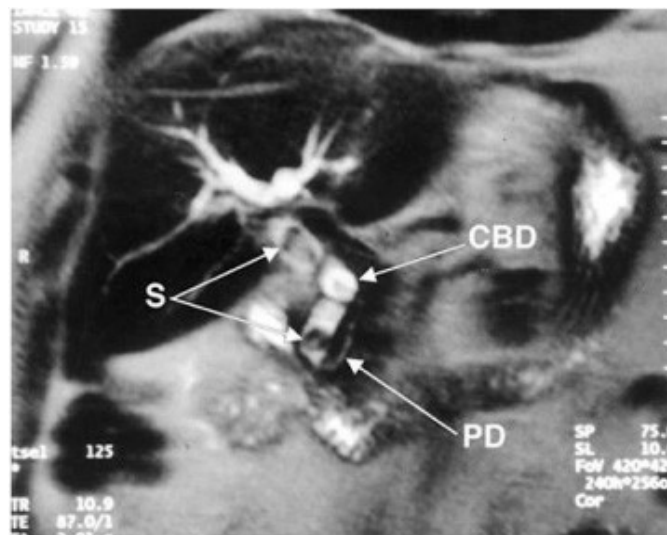


Figure 21

MRCP FINDING IN CHOLEDOCHOLITHIASIS

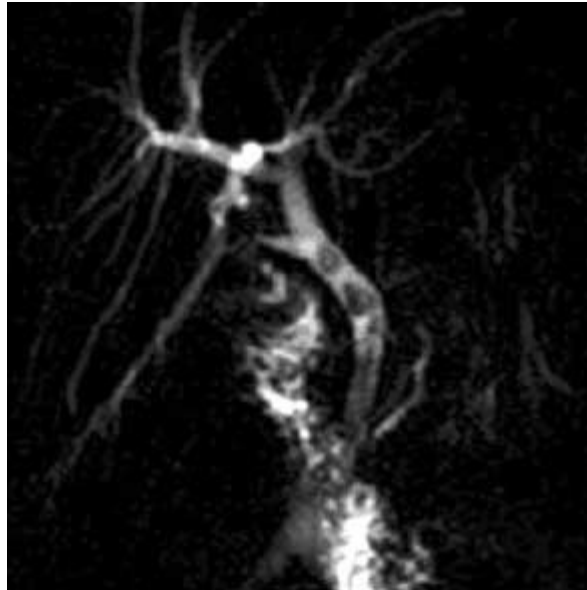


Figure 22

ERCP FINDING IN CHOLEDOCHOLITHIASIS



(5) Upper gastro intestinal Endoscopy

Preoperative UGI Endoscopy was done in all patients. It was found to be abnormal in twelve patients (27.27%) with the following findings. Pangastritis in (7 patients), distal esophagitis with antral gastritis (2patients); unhealthy mucosa in lesser curvature in (1patient); active duodenal ulcer in (2 patients)

(6) Endoscopic Retro grade Cholangio pancreatography (ERCP)

ERCP has become the diagnosis and therapeutic tool of choice in patients with choledocholithiasis. In our institution because of lack of therapeutic arm ERCP could not be done. Interventional procedure was done elsewhere in eight patients. Out of eight patients, 4 underwent stenting, 2 underwent sphincterotomy alone and 2 underwent sphincterotomy and

stenting. Patients who had stents were removed preoperatively. Laparoscopic cholecystectomy followed by ERCP interventional procedure has become the gold standard in the management of choledocholithiasis.

- Small stones can be retrieved with a dormia basket or a fogarty balloon catheter with an intact papilla. In majority of situation, a sphincterotomy is needed before the stones can pass. Stones smaller than 1cm pass spontaneously within 48hours. Stones that are 1 to 2 cm in diameter require extraction with the dormia basket or fogarty catheter in addition to sphincterotomy. Stones larger than 2cm in diameter require further treatment with lithotripsy or chemical dissolution with mono-octanin (Cholesterol stone) and (via) a nasobiliary tube has been considered. If stone extraction is unsuccessful, a biliary drainage procedure, whether internal or external is performed. Figure 22 show ERCP with filling defect in CBD.

(7) Percutaneous transhepatic cholangiography (PTC)

PTC may be modality of choice in patients in whom ERCP is difficult (e.g) those with previous gastric surgery or distal obstructing CBD stone or lack of an experienced endoscopist; and in patient with extensive intra hepatic stone disease and cholangio hepatitis. A long large bore needle is advanced percutaneously and transhepatically into an intra hepatic duct and cholangiography performed

Percutaneous extraction can be done through PTC tract. An external biliary catheter is placed and the tract dilated over several weeks (2-6wks) up to 16F size by placement of progressively large catheter & CBD stone is extracted using a dormia basket or a choledochoscope. Morbidity and mortality are 10% and 1% respectively. Success rate of CBD stone extraction is 75-85%.

INTRA OPERATIVE STUDIES

- Choledochoscopy
- Cholangiography
- Intraoperative ultrasound

CHOLANGIOGRAPHY

An area of debate is the use of routine intra operative cholangiography (IOC) during a cholecystectomy. The argument in favour of routine IOC is that it provides accurate information about biliary anatomy and the presence of CBD stones. In operative cholangiography six techniques are used.

- 1) Cystic duct cholangiography during laparoscopic cholecystectomy
- 2) Cystic duct cholangiography during open cholecystectomy
- 3) Cholecysto cholangiography when gall bladder is present
- 4) Common duct cholangiography when gall bladder is absent or when CBD is dilated
- 5) Transhepatic cholangiography when the anatomy of extra hepatic bile duct is unclear or distorted from multiple previous operation on the bile ducts and
- 6) Post exploration T tube cholangiography performed after exploration of CBD
- 7) Though cholangiogram is not routinely used in our institution, we performed T tube cholangiogram in 6 patients (13.63%).

T tube cholangiography

18F T tube is employed in most patients, so that post operative extraction of any retained stones through mature T tube tract is possible. T tube cholangiography performed in selected patients one week following CBD exploration. T tube removed on 12th-14th postoperative period if there is no retained stone. T tube cholangiography reduces the

likelihood of finding a residual stone on a later post operative T tube cholangiography from 30 to 7% ³⁹. Operative choledochoscopy can reduce the incidence of retained bile duct stones to 2% or less ⁴⁰.

Completion T tube cholangiography is used to fill the right upper quadrant with saline solution; saline is then used to irrigate and remove all air from the biliary system. A 20ml syringe is attached directly to T tube. Two cholangiography are obtained one after the instillation of approximately 5ml of contrast medium and the second after the instillation of additional 10ml.

It is important to position the patient in such a way that CBD is to right of and does not overlie the lumbar spine. The injection rate should be slow . The entire biliary system, including the intra hepatic and extra hepatic bile ducts and flow of contrast into the duodenum should be demonstrated.

(2) Intra operative ultrasound

Special probes are used to visualize the biliary tree. It can be performed by either open or laparoscopic technique. IOU has a positive predictive value of approximately 75%. Recent introduction of small high frequency probe in a 6F sheath, performing intraluminal ultrasonography is now possible. Sensitivity is similar to intra operative cholangiogram. Operator dependency limits usefulness of this modality.

PREOPERATIVE MANAGEMENT OF PATIENTS WITH OBSTRUCTIVE JAUNDICE

Adequate timing of surgical intervention and preparation of patient for surgery are essential in management of patients with obstructive lesion of biliary tract. Adequate preparation entails the correction of metabolic abnormality, improvement of general condition and institution of specific measures designed to minimize the incidence of complication associated with prolonged or severe cholestasis.

DIET:

1. High intake of carbohydrate is essential and amino acid solution containing aromatic amino acid should be used sparingly as they may precipitate encephalopathy.
2. Oral diet is safest and used whenever possible.
3. Elemental diet supplementation in nutritionally compromised patients.

DRUGS

Oral administration of bile salts or lactulose to reduce the intestinal absorption of endotoxin from intestinal microflora and thus minimizing the incidence of renal failure following surgical intervention

ELECTROLYTE IMBALANCE

- Hypokalemia is frequently present and should be corrected
- Isotonic saline should be restricted as the total exchangeable body sodium is elevated.

INFECTION

Infection of biliary tract is much more commonly present in ductal calculus disease. Number of clinical trials have shown that postoperative sepsis in patient having biliary tract surgery is generally reduced by use of short term prophylactic antibiotics, either cephalosporin or aminoglycoside or piperacillin in high risk group. In patients with acute cholangitis with unknown microbiology, antibiotic selection must include the gram negative aerobes and possibly enterococci.

Antibiotics commonly used are

GM Negative aerobe

1. Aminoglycosides such as gentamycin and tobramycin
2. Third generation cephalosporin
3. Ureidopenicillin : Piperacillin (GM positive coverage)
4. Carbapenams : Imipenam and meropenam (GM positive anaerobes)
5. Fluoroquinolones : Travafloxacin (GM negative aerobic and anaerobic coverage)

In pseudomonas

Piperacillin; cefipime (4th generation cephalosporin); carbapenams ,
travofloxacin

Coagulation disorder

- Prolonged prothrombin time resulting from deficiency of vitamin K-dependent factor is most commonly encountered in obstructive jaundice.
- Intramuscular injection of phytomenadione (10-20mg) will reverse clotting

deficiency within 1-3days. If not corrected , fresh frozen plasma administered to cover perioperative period .

- Severe bleeding in jaundiced patients suspect DIC due to circulating endotoxemia.. For DIC, monitor fibrinogen levels, fibrin degradation products and platelet count. This condition requires control of infection and specific treatment with fresh frozen plasma alone or in combination with heparin .

Renal failure

- Renal failure in obstructive jaundice is well known. Adequate hydration and pre-operative induction of a natriuresis / diuresis reduces the incidence of renal failure.
- Intra venous fluids (5% dextrose saline) for 12-24hours before surgery This is followed by a osmotic diuretic (mannitol) and a loop diuretic (frusemide) administered intravenously at the time of induction of anaesthesia.
- Preoperative administration of oral chenodeoxycholate commencing few days before surgery has shown to reduce the incidence of renal failure
- Administration of oral lactulose has shown to reduce the incidence of renal failure in jaundiced patient .

SURGICAL PROCEDURE

After adequate nutrition, antibiotics and correction of electrolyte and coagulation disorders, the patients were subjected to surgery. Incisions commonly used were right subcostal (30patients), midline incision (12patients); and bilateral subcostal incision in (2patients). Except for five patients who already had history of

cholecystectomy, all the remaining thirty nine patients underwent cholecystectomy.

The traditional approach in the treatment of symptomatic gall stones and choledocholithiasis has been open cholecystectomy and CBD exploration. Recently with widespread acceptance of laparoscopic cholecystectomy for the treatment of symptomatic gall stones, the management of common bile duct stone has become even more controversial.

MANAGEMENT OPTIONS FOR CHOLEDOCHOLITHIASIS

1. Open cholecystectomy followed by open choledochotomy and stone retrieval
2. Pre-cholecystectomy or post-cholecystectomy endoscopic retrograde cholangiography and papillotomy with stone removal
3. Laparoscopic cholecystectomy with CBD exploration
4. Percutaneous transhepatic stone extraction
5. Open cholecystectomy with open choledochotomy with stone removal followed by choledochoduodenostomy or choledochojejunostomy
6. Open cholecystectomy with choledochotomy with stone removal followed by T tube drainage.
7. Open cholecystectomy with choledochotomy with stone removal followed by primary closure of choledochotomy

CHOLECYSTECTOMY

The open approach continues to be a safe and effective therapy for the treatment of complicated gall stone disease with choledocholithiasis. Management of patients with CBD stone from both quality and economic perspective includes preoperative ERCP with papillotomy followed by laparoscopic cholecystectomy. Unfortunately many patients are not candidate for this approach due to nonavailability of ERCP.

Cholecystectomy is done in two ways

1. Cholecystectomy from neck toward fundus (Commonly done)
2. Cholecystectomy from fundus toward cystic duct

In our study out of thirty eight patients who underwent cholecystectomy, 18 patients had cholecystectomy from neck towards fundus and 20 patients had cholecystectomy from fundus to neck. If the anatomy cannot be clearly identified, the gall bladder should be dissected from fundus downward towards the gall bladder neck, making ductal and vascular anatomy easier to identify.

The extra hepatic bile duct can be examined best from the left side of the operating table by palpating the hepatoduodenal ligament between the left thumb anteriorly and the forefinger in the foramen of Winslow. The duodenum must be mobilized (Kocher's maneuver) to allow adequate palpation of the distal CBD and the ampulla.

Choledochotomy

The site of choledochotomy depends on several factors. Choledochoduodenostomy or Choledochojejunostomy may become necessary and therefore opening must be in the lowest part of supra duodenal CBD that is consistent with an easy subsequent

anastomosis. As much as possible, the common duct is left proximally in case the duct is needed for some further procedure [(e.g) repair of a stricture] in this part of the duct. Choledochotomy should be placed distally and close to the duodenum so that the usual distance from this point to the papilla measures $\pm 7\text{cm}$ Figure 23 shows Choledochotomy

EXPLORATION OF THE DUCT

Exploration should be as atraumatic as possible. Desjardin's forceps or fogarty balloon is used to explore the CBD. Desjardin's forceps is used to grasp larger size stones and fogarty balloon is used to remove smaller size stone and sludge. This is followed by introduction of flexible choledochoscopy to examine the CBD, common hepatic duct, the right and left hepatic duct and even further up to second order bile duct. If any stone detected, it is removed by using dormia basket.

Fogarty probe can be used for retrieval of small stone and sludge. The catheter is passed into the duodenum and the balloon inflated and catheter with drawn until it impinges against the papilla. The catheter is held by the syringe on the left hand and the degree of inflation controlled by the thumb and the plunger. With gentle traction superiorly the catheter is gradually pulled up to choledochotomy site, care being taken to prevent any stone slipping in to proximal biliary tree. The catheter is withdrawn and reinserted into each of the main hepatic ducts and the procedure is repeated.

The last step in CBD exploration is to irrigate the duct with saline. Small stones, sludge or debris can be flushed in to duodenum or back into the choledochotomy opening by irrigating the ductal system.

T tube drainage

The standard practice is to use a T tube if the CBD size is less than 15mm and if choledochoscopy showed evidence of spasm or edema of sphincter of oddi.

T tube can become obstructed, particularly if they are tight fitting and can be difficult to extract. This can be avoided by cutting off a strip of the wall of T tube. The modified T tube is held in desjardin's forceps which conveniently grasps the T junction of the tube allowing it to be slipped into choledochotomy .

The long limb of the tube is placed at the lower end of the opening and repair commenced just above the upper apex of the incision using continuous or interrupted resorbable material. The final stitch should be close to the opening against the T tube.

The proximal limits of T tube should not enter one of the hepatic ducts as this can produce obstruction. The distal end must not enter the duodenum as this can act as a siphon. In addition, a tube through the papillary orifice may produce pancreatitis. The correct position of T tube is with the long limb emerging under the costal margin laterally. T tube cholangiogram taken about 5-7days after the operation, provided this is normal removed by gentle traction. In our study we did six cases (13.63%) of T tube drainage after CBD exploration and none of the patient showed residual stone on T tube cholangiogram. Figure 24 & 25 shows T tube drainage.

Choledochoduodenostomy

In our experience we performed 31 patients (70.45%) with Choledochoduodenostomy and is the commonest procedure done in our institution following CBD exploration with flexible choledochoscopy.. It should not be performed with the ducts less than 15mm in diameter and a duct narrower than 12mm is an absolute contraindication.

The circumstances in which this bypass has been effective in association with a dilated duct are

1. Retained or recurrent calculi in the choledochus or hepatic duct.
2. Cholangitis
3. Ampullary stenosis
4. Presence of primary choledochal calculi or bile stasis.
5. Tubular stricture of the transpancreatic portion of the choledochus usually due to chronic pancreatitis.
6. Low iatrogenic stricture.

Contraindication

1. Duodenal ulcer
2. Acute pancreatitis

Minimum requirement for choledochoduodenostomy is diameter of CBD should be > 15mm and the stoma should be 2.5cm. The common duct is opened through conventional longitudinal and extended to 2.5cm. In almost all instances, the incision in the duct will carry into common hepatic duct. The incision on the 1st part of duodenum is made transversely for about 2.5cm. Complete the posterior suture to approximate the CBD

to the posterior duodenal incision and sutures are tied so that knots are within the lumen. Anterior suture is similarly approximated using interrupted sutures with the knots tied outside. A choledochoduodenostomy is generally preferred because it is simpler and quicker and permits easy endoscopic access if necessary⁴¹.

Figure 26, Shows choledochoduodenostomy

Choledochojejunostomy

The technique is usually used to treat when Choledochoduodenostomy is not technically possible. Figure 27 & 28 shows choledochojejunostomy .

- The bile duct is transected, the distal portion is oversewn and an end to side choledochojejunostomy performed
- Biliary intestinal continuity is established either by a loop of jejunum or a roux en y loop. Many surgeons prefer single layer anastomosis usually with 3-0 Dexon or Vicryl
- Choledochojejunostomy with a large CBD (2.5cm) does not need to be stented. If choledochojejunostomy is performed with a normal caliber duct, it may be prudent to stent the anastomosis.
- In our study we performed one case of choledochojejunostomy for a patient who underwent choledochal cyst excision done previously.

Primary closure of the CBD

Routine drainage of CBD following choledochotomy is unnecessary as it prolongs hospital stay and increases post operative morbidity ^{42,43}. The use of T tube is associated with complication like bile leak, dislodgement and even breaking of T tube, formation of

encrustations leading to difficulty in removal of tube, duct stricture, cellulitis around the T tube, cholangitis, trauma to duct and subsequent biliary leak during tube removal and delayed healing of the CBD wound. The continuous external drainage of bile can sometime lead to nutritional disturbances

Inclusion criteria for primary closure

1. All stones are thoroughly removed.
2. There is no stenosis or obstruction in ampulla of vater and sphincter, which is determined by gentle passage of 12F rubber catheter or 18F metal probe through papilla into the duodenum.
3. Choledochoscopy shows no severe inflammation on the wall of the duct.
4. Absence of pancreatitis.

T tube drainage following choledochotomy is associated with increased bile infection and wound infection. Significant bile leak following T tube removal is said to occur in 1.2 to 30% ⁴⁴. External loss of bile through the T tube may lead to anorexia and constipation (Postcholedochostomy acidotic syndrome) ⁴⁵. The use of T tube following routine choledochotomy is unnecessary and increase post operative morbidity and mortality. Many papers reported by different authors ^{46,47,48}. support the direct closure of duct immediately after exploration. We underwent 6 patients (13.63%) with primary closure of CBD without T tube drainage and none had postoperative complication.

Figure 23

CHOLEDOCHOTOMY

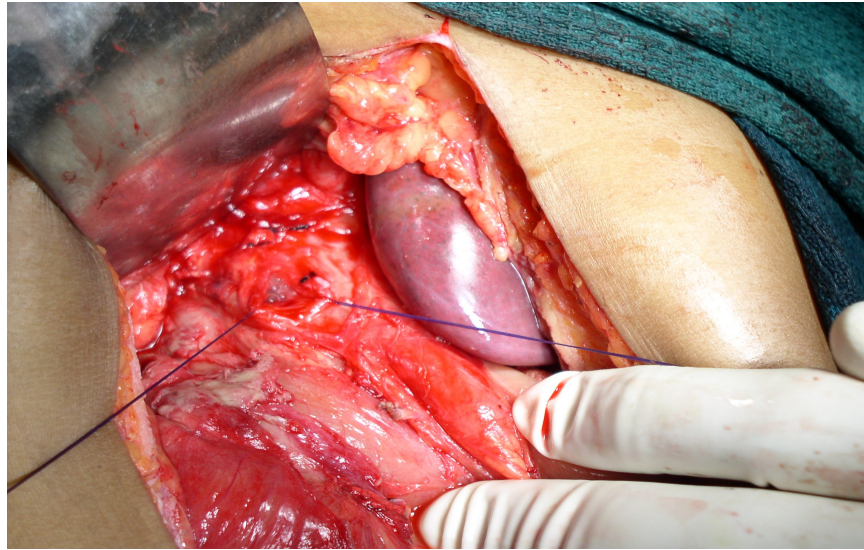


Figure 24

T TUBE DRAINAGE

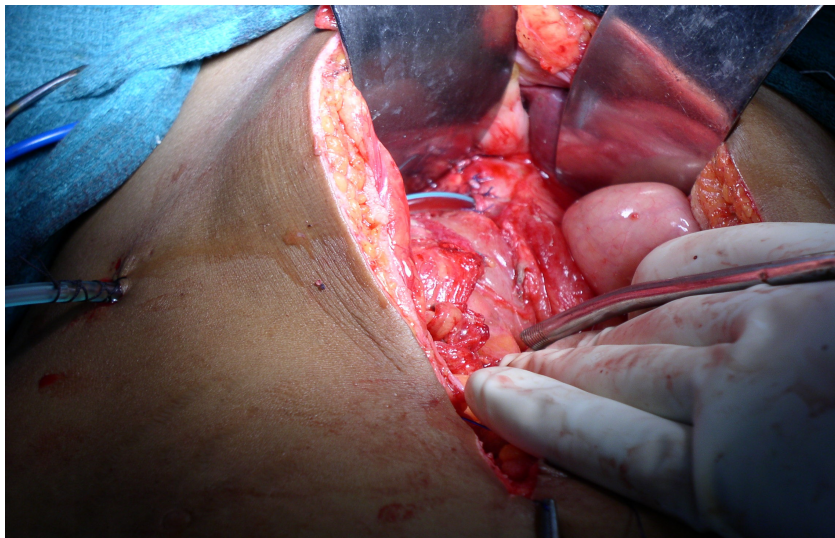


Figure 25

T TUBE DRAINAGE

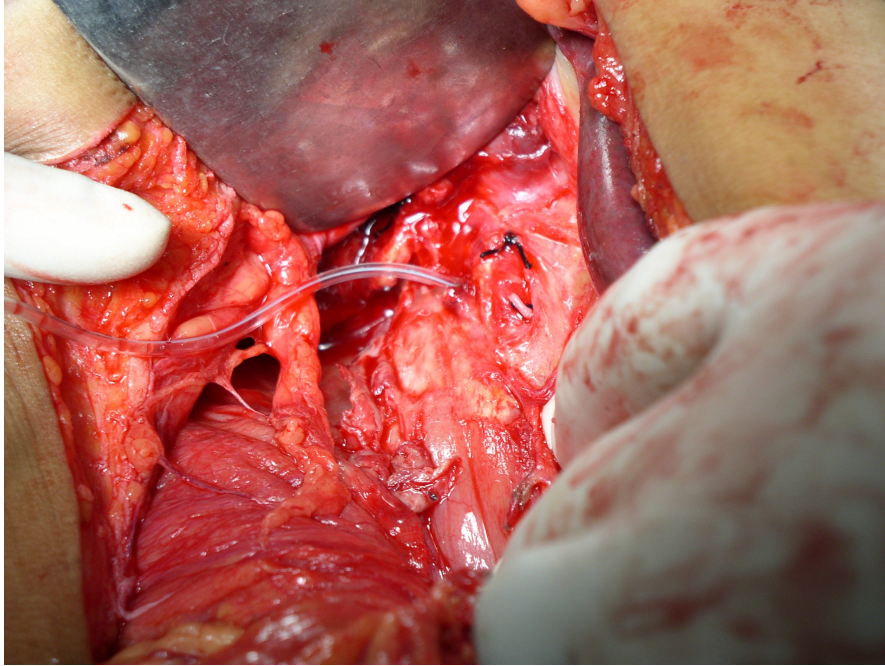


Figure 26

CHOLEDOCHODUODENOSTOMY

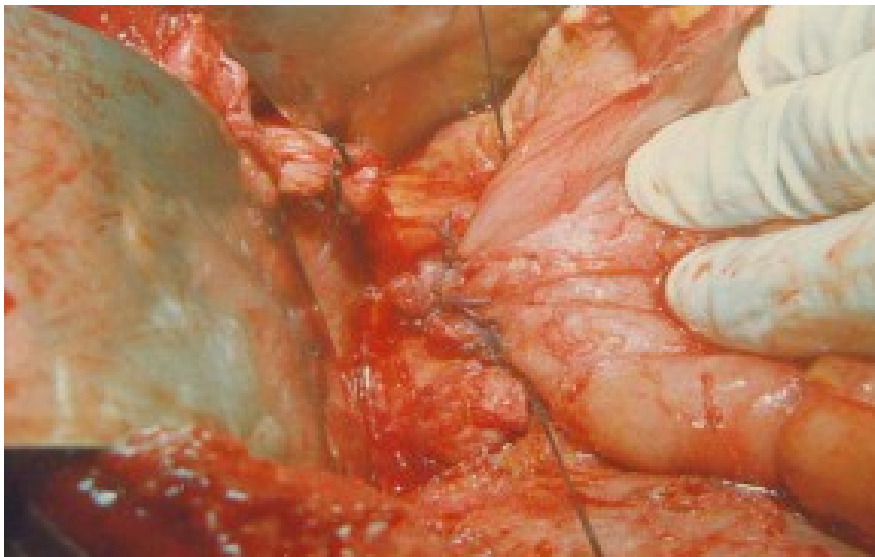


Figure 27

CHOLEDOCHOJEJUNOSTOMY

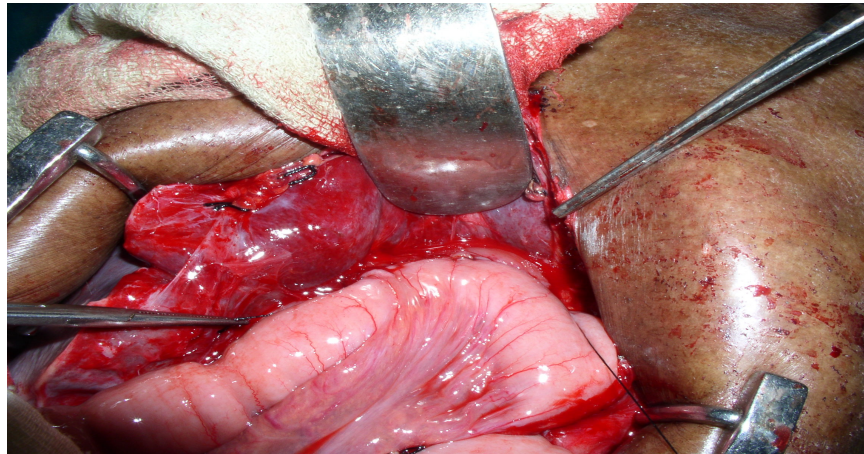
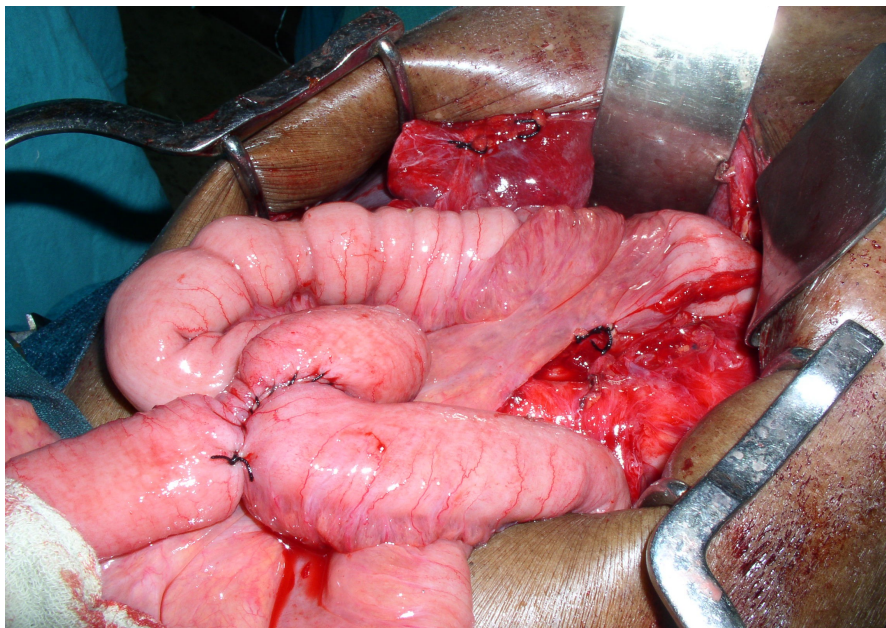


Figure 28

CHOLEDOCHOJEJUNOSTOMY



TRANS DUODENAL SPHINCTEROPLASTY

The role of transduodenal sphincteroplasty in the management of CBD stone is controversial. We have not performed this procedure and it needs mention because of its indication in some conditions

It is indicated in

1. Failure of endoscopic sphincterotomy
2. In patients with billroth II gastrectomy
3. In papillitis, where patency of the papillotomy has to be assured long term.
4. In pancreatitis when a drainage procedure of distal duct of wirsung is indicated.
5. Impacted ampullary stone
6. Multiple CBD stone
7. Recurrent CBD stone
8. Papillary stenosis

Contraindicated in

1. CBD diameter >2cm
2. Long sphincter stricture >15mm
3. Peri-vaterian diverticulum
4. Duodenal wall and head of pancreas severely inflamed (Barraya et al) ⁴⁹.

COMPLICATIONS

In general the complication encountered in concomitant use of choledochoscopy and other surgical procedures include cholangitis, post operative pancreatitis, bile duct injury / perforation and haemorrhage, bile leak, wound infection, hepatic vascular injury, transient fever, biliary fistula, liver failure and cirrhosis, sepsis, renal failure, respiratory

insufficiency, retained or impacted stone, pneumonia and deep vein thrombosis.

Injury to CBD is very rare. It is common while using a rigid scopy rather than flexible choledochoscopy. Injury to bile duct avoided if a clear endoscopic field of view is maintained, so that all manipulation of stones are performed under direct endoscopic observation. Basket entrapment can occur if the stone is too large to be removed and captured in the basket. In our study we came across wound infection as a common complication in 14 patients(31.81%) and two patients (4.55%) had bile leak and one patient showed retained stone (2.27%)

CONCLUSION

It is now well established that choledochoscopy reduces the incidence of retained common bile duct stones in patients with choledocholithiasis. Hence we recommend that operative choledochoscopy should always be done after exploration of the common bile duct stones to reduce the incidence of retained stone.

Surgical exploration of CBD with conventional method without the use of choledochoscopy have shown 8 to 16% of patients with retained stones . With the use of choledochoscopy, the incidence is reduced to 2% as quoted in various studies. In our study percentage of retained stone after flexible choledochoscopy was (2.27%) .

Females were commonly affected by choledocholithiasis. The commonest age group was between 51-60yrs. Commonest complaint was pain or jaundice

Though the gold standard in the management of choledocholithiasis is precholecystectomy or postcholecystectomy ERCP and sphincterotomy and retrieval of stones. Conventional use of choledochoscopy gives equivalent results as that of ERCP in the diagnostic and management of CBD stones. Hence in centers where ERCP facilities are lacking, flexible choledochoscopy plays a major role in reducing the retained stones in CBD. Since patients with choledocholithiasis may be completely asymptomatic, choledochoscopy should be done as a routine in suspected patients. Choledochoduodenostomy, Choledochojejunostomy, T tube drainage & primary closure of CBD after CBD exploration with flexible choledochoscopy has a definitive role in the management of choledocholithiasis.

Post operative MRCP has played a major role in detecting stones even smaller than 4mm. Hence MRCP should be used as a preoperative and post operative evaluation of choledocholithiasis.

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MASTER CHART

S.NO	I.P.NO	G.E.NO	AGE	SEX	DIAGNOSIS	INCISION	TRANSCYSTIC CD	TRANSCHOLEDOCHOTOMY CD	T.TUBE	C.D.D	C.D.J	PRIMARY CLOSURE	CBD SINGLE STONE	CBD MULTIPLE STONE	CBD DIAMETER MM	MRCP
1	64493 1	88/04	55	F	CC/CDL	RSC		√		√			√		15	-
2	64380 8	72/04	38	F	CDL	RSC		√		√			√		18	-
3	65288 2	140/04	35	F	CC/CDL	MID		√		√			√		16	-
4	68439 3	268/04	50	M	CC/CDL	MID		√		√				√	18	-
5	68439 3	281/04	56	F	CL/CDL	RSC		√		√				√	20	-
6	68493 0	282/04	40	M	CC/CL/CDL	MID		√	√				√		12	
7	81242 5	234/05	57	M	CC/CDL	RSC		√		√			√		15	-
8	71274 0	98/05	65	F	CC/CDL	RSC	√			√				√	20	-
9	73891 7	219/05	43	F	CL/CDL	RSC		√		√			√		15	-
10	71351 7	102/05	60	F	CC/CL/CDL	MID		√		√			√		16	-
11	74765 3	254/05	65	F	CL/CDL	RSC		√		√			√		20	-
12	74772 2	284/05	28	M	CC/CDL/LHD STONE	MID		√		√				√	18	RETAINED STONE
13	74254 9	286/05	21	F	CDL/CHD STRICTURE	BSC		√			√		√		6	-
14	70173 1	13/05	45	M	CC/CL/CDL	MID		√				√	√		18	-
15	78030 1	139/06	29	M	CC/CDL	RSC		√		√			√		18	-
16	791186	141/06	47	M	CDC	RSC		√		√			√		25	-
17	77995 8	78/06	62	F	CC/CDL	RSC		√		√			√		18	-
18	77569 6	22/07	23	M	CDL	RSC		√		√				√	15	-

19	78885 2	114/06	55	F	AC/CL/CDL	RSC	√		√				√		11	-
20	77517 9	19/06	24	F	CC/CDL	RSC		√	√				√		14	-
21	77807 5	25/06	57	M	CC/CDL	RSC		√					√	√	12	-
22	79391 5	130/07	62	F	CC/CDL	RSC		√					√	√	15	-

S.NO	LPNO	G.NO	AGE	SEX	HOSPITALSTAY	H/O SURGERY	PAST H/O JAUNDICE	CLAY STOOLS	JAUNDICE	BILIRUBIN-PRE	ALK-PO4-PREOP	MRCP-PREOP	UGL	GB-SINGLE STONE	GBMULTIPLESTONE	POT-TUBE CHOLAN	BILIRUBIN-POST	ALK-PO4-POSTOP	PRE-OP ERCP	COM ORBIDILLNESS
1	644931	88/04	55	F	23	-	√	-	√	2.8	245	-	N	-		-	.8	210	-	-
2	643808	72/04	38	F	22	√	√	√	√	12.6	115	-	N	-	-	-	1.8	182	-	√
3	652882	140/04	35	F	21	√	-	√	√	7.2	132	-	N	-	-	-	1.8	132	√	-
4	684393	268/04	50	M	13	-	√	-	√	4	344	-	A	-	-	-	1.2	148	√	-
5	684393	281/04	56	F	29	-	-	√	√	5.6	788	-	N	-	√	-	1.8	128	-	-
6	684930	282/04	40	M	19	-	-	√	√	12	258	-	N	-	-	√	1.8	198	-	-
7	812425	234/05	57	M	49	-	√	-	-	.9	176	-	A	-	-	-	.9	164	-	√
8	712740	98/05	65	F	32	-	-	-	-	1.8	210	-	N	-	√	-	.9	180	-	√
9	738917	219/05	43	F	35	√	-	-	√	4.6	129	-	A	-	-	-	2.1	120	-	-
10	713517	102/05	60	F	56	√	-	-	-	1.7	112	-	N	-	√	-	.7	106	-	√
11	747653	254/05	65	F	25	-	-	-	√	5.5	146	-	A	-	√	-	2.1	126	-	-
12	747722	284/05	28	M	26	√	-	√	√	7.8	179	-	A	-	-	-	2.2	120	-	-
13	742549	286/05	21	F	57	√	√	√	√	5.5	112	√	N	-	-	-	1.8	104	-	-
14	701731	13/05	45	M	17	-	-	-	√	14	467	-	N	√	-	-	1.9	163	-	-
15	780301	139/06	29	M	64	-	-	√	√	2.1	384	√	N	-	-	-	1.4	404	-	-
16	791186	141/06	47	M	32	-	-	-	-	.8	198	-	A	-	-	-	.8	190	-	-
17	779958	78/06	62	F	18	-	-	-	-	.9	109	-	N	-	√	-	2.4	170	√	√
18	775696	22/07	23	M	28	√	√	-	√	2.1	552	-	N	-	-	-	1.6	212	-	-
19	788852	114/06	55	F	30	-	-	-	-	1.2	226	√	N	-	-	√	1.2	186	-	-
20	775179	19/06	24	F	27	-	-	√	√	4.6	127	-	N	-	-	√	1.6	186	-	-
21	778075	25/06	57	M	23	-	√	-	-	1.7	212	-	N	-	-	-	1.2	188	-	-
22	793915	130/07	62	F	19	-	√	-	√	3.1	110	-	N	-	-	-	1.1	112	√	-

CC	:	Chronic cholecystitis
CDL	:	Choledocholithiasis
CL	:	Cholelithiasis
LHD	:	Left Hepatic duct
CHD	:	Common Hepatic duct
AC	:	Acute Cholecystitis
RSC	:	Right Subcostal
MID	:	Midline
BSC	:	Bilateral Subcostal